ZooKeys 13: 43-55 (2009)
doi: 10.3897/zookeys.13.174
www.pensoftonline.net/zookeys

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

A description of *Paractenopsyllus madagascarensis* sp. n. and the female of *Paractenopsyllus raxworthyi* Duchemin & Ratovonjato, 2004 (Siphonaptera, Leptopsyllidae) from Madagascar with a key to the species of *Paractenopsyllus*

Michael W. Hastriter[1,†], Carl W. Dick[2,‡]

1 *Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah, U.S.A.* **2** *Department of Zoology, Field Museum of Natural History, Chicago, Illinois, U.S.A.*

† *urn:lsid:zoobank.org:author:8ED93E69-50DF-49B2-B990-93A1C7956A96*
‡ *urn:lsid:zoobank.org:author:DB6C70D0-E6A4-4401-9980-DE807DB86CF3*

Corresponding author: *Michael W. Hastriter* (michaelhastriter@comcast.net)

Academic editor: *Terry Galloway* | Received 16 April 2009 | Accepted 18 June 2009 | Published 30 June 2009

urn:lsid:zoobank.org:pub:5D2F4F0B-5786-4DEF-8414-650C511153EB

Citation: Hastriter MW, Dick CW (2009) A description of *Paractenopsyllus madagascarensis* sp. n. and the female of *Paractenopsyllus raxworthyi* Duchemin & Ratovonjato, 2004 (Siphonaptera, Leptopsyllidae) from Madagascar with a key to the species of *Paractenopsyllus*. ZooKeys 13: 43-55. doi: 10.3897/zookeys.13.174

Abstract

An alcohol collection of 990 fleas from Madagascar (2003-2005) was deposited in the Field Museum of Natural History, Chicago, and recently made available for study. Among the material were two new and undescribed taxa. The male and female sex of *Paractenopsyllus madagascarensis* **sp. n.** is described and host associations are discussed. In addition, a description of the heretofore unknown female of *Paractenopsyllus raxworthyi* Duchemin & Ratovonjato, 2004 is provided. The tenrec *Microgale drouhardi* G. Grandidier, 1934 is also reported as a new host record for *P. raxworthyi*. Host associations for all known records of species of *Paractenopsyllus* are presented as a table and a key to the known species of *Paractenopsyllus* is included.

Keywords

host parasite, key, Madagascar, *Paractenopsyllus*

Copyright *Michael W. Hastriter, Carl W. Dick*. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Introduction

Fleas collected in Madagascar by Steven Goodman and colleagues during 2003-2005 were deposited in the Field Museum of Natural History (FMNH), Chicago, Illinois. These alcohol preserved specimens were recently loaned to the senior author for identification. Noteworthy among them was a series of *Paractenopsyllus* species. The genus *Paractenopsyllus* Wagner, 1938 includes 17 valid species. This leptopsyllid genus is closely allied to *Tsaractenus*, both endemic to Madagascar. *Paractenopsyllus* has evolved on host species endemic to Madagascar such as the afrosoricid family Tenrecidae Gray, 1821 (*Hemicenteles* Mivart, 1871, *Microgale* Thomas, 1882, *Oryzorictes* A. Grandidier, 1870, and *Tenrec* Lacépède, 1799) and endemic murids of the subfamily Nesomyinae Major, 1897 (*Eliurus* Milne-Edwards, 1885 and *Nesomys* Peters, 1870). Restricted to Madagascar, few records of the genus *Paractenopsyllus* have been reported except for those listed in original species descriptions. They include those by Lumaret (1962), Klein (1965a, 1965b, 1967), Klein and Grenier (1965, 1969), Duchemin (2003, 2004), and Duchemin and Ratovonjato (2004). The females of *P. beaucournui* Duchemin & Ratovonjato, 2004, *P. oconnori* Duchemin & Ratovonjato, 2004, and *P. raxworthyi* Duchemin & Ratovonjato, 2004 have not been described to date. The female of *P. raxworthyi* was discovered among the recent FMNH collections, and is described herein. In addition, the description of a new species of *Paractenopsyllus* is provided, a key is included for the known taxa, and a table is presented to demonstrate the host associations of all known records of *Paractenopsyllus*.

Materials and methods

Dissections of flea genitalia and mounting techniques were completed in accordance with procedures outlined in Hastriter (2004), and Hastriter and Whiting (2003), respectively. Methods of measuring fleas and preparing digital images follow those outlined in Hastriter and Eckerlin (2003). Mammal nomenclature follows Wilson and Reeder (2005) and anatomical terms for flea structures are adapted from those of Rothschild and Traub (1971). Unless otherwise specified, numbers used within descriptions apply to only one side of specimens mounted laterally on microscope slides. All specimens are deposited in the Field Museum of Natural History collection unless specified as Brigham Young University (BYU), or the senior author's collection.

Leptopsyllidae

Key to Species of *Paractenopsyllus*

This key is a modification of the key presented in Duchemin and Ratovonjato (2004).

1 Females (unknown for *P. oconnori* and *P. beaucournui*) **2**
– Males **17**
2 Pronotal comb with more than 28 teeth **3**
– Pronotal comb with 28 or fewer teeth **4**
3 Caudal margin of S-7 with two lobes ..... ***P. kerguisteli* Wagner, 1938**
– Caudal margin of S-7 with one narrow elongated lobe ..... ***P. madagascarensis* sp. n.**
4 Caudal margin of S-7 with two lobes (exclusive of apical ventral margin) ... **5**
– Caudal margin of S-7 with one lobe (exclusive of apical ventral margin) ... **12**
5 Bulga of spermatheca much longer than wide (length twice width) **6**
– Bulga more spherical or elliptical (length less than or equal to 1.5× width) ... **7**
6 Dorsal and ventral lobes on caudal margin of S-7 broad and obtusely rounded (Fig. 15) ..... ***P. raxworthyi* Duchemin & Ratovonjato, 2004**
– Dorsal lobe rounded, but ventral lobe acutely pointed at apex ..... ***P. vauceli* Klein, 1965**
7 Ventral lobe of S-7 acutely pointed at apex... ***P. ratavonjatoi* Duchemin, 2004**
– Ventral lobe of S-7 rounded **8**
8 Bursa copulatrix angular forming two 90 degree angles... ***P. petiti* Klein, 1965**
– Bursa copulatrix with no right angles **9**
9 Ventral margin of S-7 with shallow sinus at most ..... ***P. duplantieri* Duchemin, 2004**
– Ventral margin of S-7 with distinct deep sinus **10**
10 Ventral sinus of S-7 angular at deepest point ..... ***P. albignaci* Klein, 1967**
– Ventral sinus of S-7 rounded and not angular **11**
11 Ventral lobe of S-7 distinctly narrower than dorsal lobe and elongated well beyond dorsal lobe and apex of ventral edge of sternite ..... ***P. pauliani* Lumaret, 1962**
– Ventral lobe broader than dorsal lobe; extending only slightly beyond dorsal lobe and shorter than apex of ventral edge of sternite ..... ***P. juliamarinus* Duchemin, 2004**
12 Setae of frontal row fine and not thickened or spiniform **13**
– One or more setae of frontal row thickened or spiniform **15**
13 Perula extremely dilated; bursa copulatrix scarcely longer that width of dilated perula ..... ***P. goodmani* Duchemin, 2003**
– Perula not much more dilated than width of bursa copulatrix **14**
14 Lobe of S-7 rounded, extending far beyond ventral apex of sternite; sinus subtending lobe, much narrower that width of lobe ..... ***P. rouxi* Duchemin, 2004**

– Lobe of S-7 somewhat angular; sinus much wider than dorsal lobe..... ..... ***P. grandidieri*** **Klein, 1965**

15 Lobe of S-7 and ventral apex of sternite acutely pointed; sinus between broadly flattened at base.....***P. viettei*** **Klein, 1965**

– Lobe of S-7 rounded at apex; sinus rounded at base.....**16**

16 Vertical distance between ventral margin of S-7 and dorsal margin of sclerite longer than horizontal width of S-7 from anterior edge to apex of lobe..... .....***P. randrianasoloi*** **Klein, 1967**

– Vertical width of S-7 less than horizontal width... ***P. gemelli*** **Duchemin, 2004**

17 Apex of median dorsal lobe narrowly rounded, even drawn out as narrow lobe.....**18**

– Apex of median dorsal lobe broadly rounded, never lobate **21**

18 Sternum eight with sinus on caudal margin and a dorsal lobe .... ***P. grandidieri*** **Klein, 1965**

– Sternum eight without a sinus or dorsal lobe on caudal margin **19**

19 Proximal lobe of distal arm of S-9 expanded postad into triangle; apex of median dorsal lobe nearly forming a right angle..... ***P. petiti*** **Klein, 1965**

– Proximal lobe of distal arm of S-9 not expanded, nearly parallel; apex of median dorsal lobe much less than a right angle **20**

20 Telomere short (length 3× maximum width); apodeme of aedeagus broad (length only 3× maximum width measured from apex to base of fulcral lateral lobe) ..... ***P. ratovonjatoi*** **Duchemin, 2004**

– Telomere long (length >3× maximum width); apodeme of aedeagus narrow (length 4× or more the width).....***P. rouxi*** **Duchemin, 2004**

21 Apodeme of aedeagus long and narrow (length 4× or more maximum width).....**22**

– Apodeme of aedeagus shorter and broad (length about 3× width).....**27**

22 Apex of median dorsal lobe hooked **23**

– Apex of median dorsal lobe not hooked **25**

23 Apical lobe of distal arm of S-9 drawn out into a point..... ..... ***P. raxworthyi*** **Duchemin & Ratovonjato, 2004**

– Apical lobe blunt or globular **24**

24 Sinus formed by hook of median dorsal lobe as large as outline of lateral lobe.....***P. randrianasoloi*** **Klein, 1968**

– Sinus much smaller than outline of lateral lobe....***P. gamelli*** **Duchemin, 2004**

25 Dorsal lobe of S-8 present; subtended by sinus **26**

– Dorsal lobe absent; no well defined sinus ....***P. juliamarinus*** **Duchemin, 2004**

26 Lateral lobe present, margins minutely serrate..... ***P. madagascarensis*** **sp. n.**

– Lateral lobe absent .....***P. oconnori*** **Duchemin & Ratovonjato, 2004**

27 Proximal lobe of distal arm of S-9 as wide as, or wider than length from base to distal lobe **28**

Proximal lobe distinctly narrower that length.....**29**

28 Setae along caudal margin of S-8 interrupted; manubrium with curved angle on ventral margin ..... ***P. goodmani*** **Duchemin, 2003**

– Setae along caudal margin of S-8 complete; manubrium straight on ventral margin ..... ***P. duplantieri*** **Duchemin, 2004**

29 Caudal margin of S-8 with sinus ..... ***P. vietti*** **Klein, 1965**

– Caudal margin of S-8 without sinus **30**

30 Apex of distal arm of S-9 drawn out into a point ..... ***P. beaucournui*** **Duchemin & Ratovonjato, 2004**

– Apex of distal arm of S-9 globular, rounded **31**

31 Caudal margin of S-8 with dorsal lobe ..... ***P. albignaci*** **Klein, 1968**

– Caudal margin of S-8 entire; without indication of lobe **32**

32 Manubrium only slightly curved or hooked upward .... ***P. vauceli*** **Klein, 1965**

– Manubrium distinctly curved upward **33**

33 Ventral lobe of distal arm of S-9 without sinus at apex; ventral margin of crochet angled ..... ***P. kerguisteli*** **Wagner, 1938**

– Ventral lobe of distal arm of S-9 with sinus at apex; ventral margin of crochet rounded ..... ***P. pauliani*** **Lumaret, 1962**

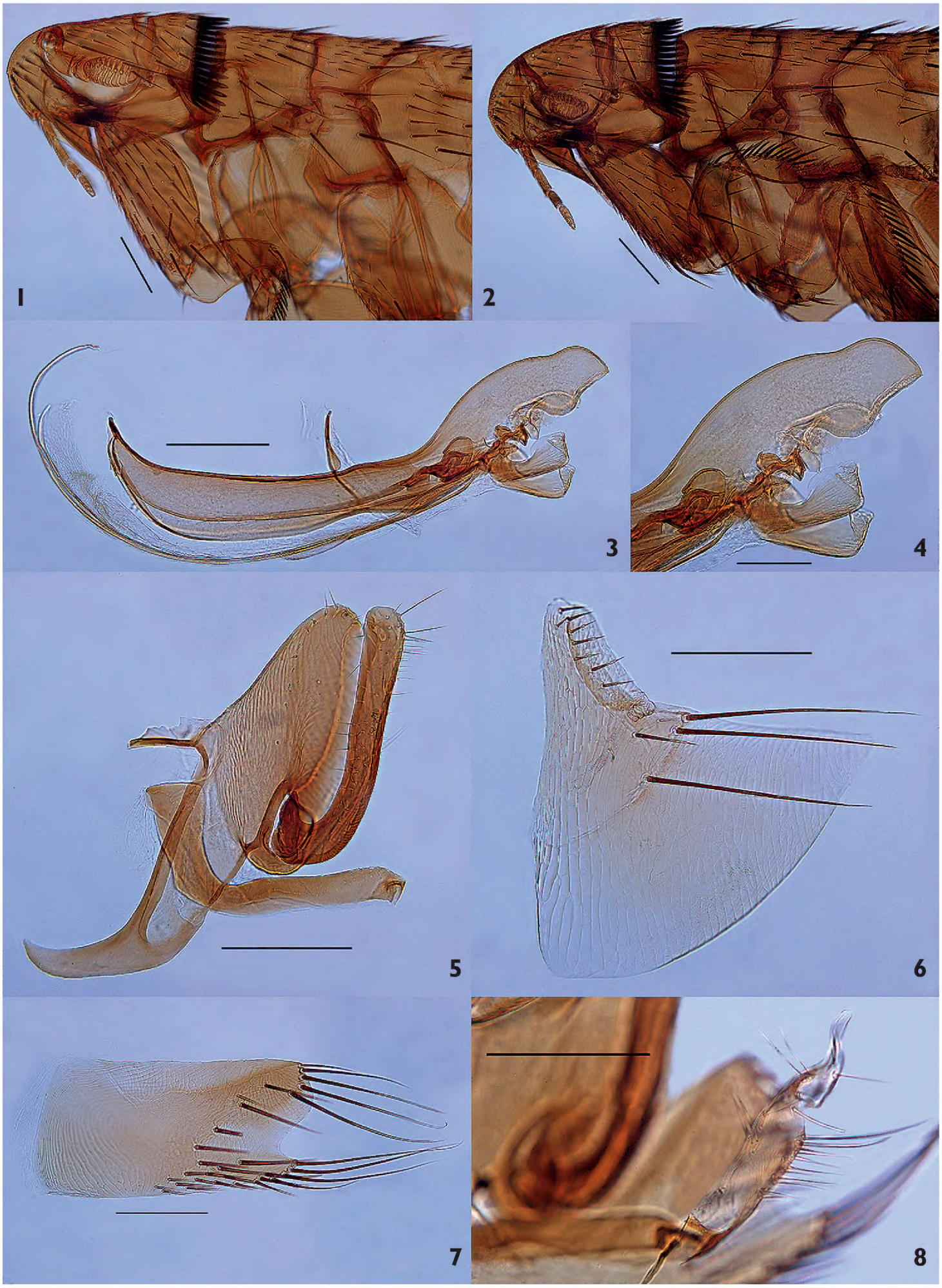
Paractenopsyllus madagascarensis **Hastriter & Dick, sp. n.**
urn:lsid:zoobank.org:act:9351B91F-FC97-47FB-B8C2-C1194681FFC8
Figs 1-13

Type Material. Holotype. ♂, 1♀ **Paratype** (SMG-13919), Fianarantsoa Province, Midongy S, Parc National de Midongy-Sud, NE slope Mt Papango (23°50'17.9982"S, 46°57'29.9988"E), 3.5 km SW Befotaka, 1250 m, ex *Eliurus tanala* Major, 1896 (FMNH-178699), 3 XI 2003, S.G. Goodman; allotype ♀, 4♂, 1♀ paratypes (SMG-13903, SMG-13924), same data as holotype except *E. tanala* (FMNH-178698, FMNH-178644), 2-5 XI 2003; 1♀ paratype (SMG-13904), same data as holotype except *Eliurus majori* Thomas, 1895 (FMNH-178686); 3♂, 7♀ paratypes (SMG-13918, SMG-13935), same data as holotype except *Eliurus webbi* Ellerman, 1849 (FMNH-178712, FMNH-178646), 3, 6 XI 2003; 1♂ paratype (SMG-13920), same data as holotype except *Gymnuromys roberti* Major, 1896 (FMNH-178717); 1♂ paratype (SMG-13905), same data as holotype except *Rattus rattus* (Linnaeus, 1758) (FMNH-178680), 2 X 2003; 1♂, 1♀ paratypes (SMG-13863, SMG-13900), Parc National de Midongy-Sud, NE slope Mt Papango (23°50'06"S, 46°57'47.9982"E), 2.5 km SW Befotaka, 875 m elev., ex *E. tanala* (FMNH-178693, FMNH-178696), 28, 31 X 2003, S.M. Goodman; 1♀ paratype (SMG-13979), W slope Mt Ambatobe, 1.2 km ENE Ampatramary, 9.5 km NE Midongy-Sud (23°30'36"S, 47°03'6.0012"E), 650 m elev., ex *E. webbi* (FMNH-178716), 14 XI 2003, S.M. Goodman; 1♀ paratype (SMG-13980), W slope Mt Ambatobe, 1.2 km ENE Ampatramary, 9.5 km NE Midongy-Sud (23°30'36"S, 47°03'6.0012"E), 650 m elev., ex *Eliurus minor* Major, 1896 (FMNH-178691), 14 XI 2003, S.M. Goodman; and 1♂ paratype (SMG-14002),

W slope Mt Ambatobe, 1.2 km ENE Ampatramary, 9.5 km NE Midongy-Sud (23°30'36"S, 47°03'6.0012"E), 650 m elev., ex *Nesomys rufus* Peters, 1870 (FMNH-178649), 16 XI 2003. The holotype, allotype, and eight pairs of paratypes are deposited in the Field Museum of Natural History, Chicago, IL, one pair of paratypes each in the U.S. National Museum of Natural History, Washington, D.C. and the Carnegie Museum of Natural History, Pittsburgh, PA, and two pairs of paratypes in the senior author's collection. Mammal host specimens are deposited in the Field Museum of Natural History, Chicago, IL.

Diagnosis. Males most closely allied with *P. oconnori* (females unknown), but distinguished by details of the aedeagus. The median dorsal lobe is expanded dorsally and greatly enlarged compared to all species except *P. oconnori*. *Paractenopsyllus madagascarensis* differs from *P. oconnori* by the presence of a distinct lateral lobe arising from the median dorsal lobe. Females differ from all other species possessing more than 28 teeth in the pronotal comb by the presence of one extremely long and narrow lobe on the caudal margin of S-VII (Fig. 9).

Description. Head (Figs. 1-2). Frontal tubercle high on frons; farther from oral angle than distance from oral angle to base of first genal tooth. Frontal row of 9 setae; middle three thickened and somewhat spiniform. Two placoids above frontal tubercle. Preantennal area with minute scattered pits bearing minute coniform peg-like structures. Heavily sclerotized incrassation at oral angle; one thick seta at base of labial palpus. Area behind frontal row with 6 long setae and 17-18 minute scattered setae (only 4 long setae in female). Tentorium visible anterior to small pigmented eye; eye with ventral notch. Two genal ctenidia off-set at bases; anterior tooth about 2/3 length of posterior. Two lucodiscs at base of second genal tooth (see Hastriter 2009). Postantennal area with 4 rows of stout setae (4, 3, 6, and 7). Three placoids present; one lucodisc dorsad between rows 3 and 4. Occipital groove lacking. Antennal fossa heavily sclerotized from eye to falx and from falx to angle of scape. Scape with oblique row of 6 fine setae; two at dorsal apex. Pedicel with 8-10 fine marginal setae; none extended beyond basal segment of clavus. Clavus not extended onto prosternum. Penultimate segment of labial palpus shortest. Maxilla sharply pointed; palpus of 5 segments. **Thorax** (Fig. 1-2). Pronotum with two rows of setae (8, 6); pronotal ctenidia with 31 spines. Three lucodiscs present. Prosternum with heavily sclerotized phragma extended beneath ventral portion of pronotal ctenidia. Mesonotum with two rows of setae (6, 5); anterior group of scattered smaller setae. Mesepisternum with 3 setae (6 in female); mesepimeron with 4 setae. Pleural rod bifurcate at dorsal third. Mesosternum heavily sclerotized; truncate. One stout pseudoseta under hyaline mesonotal collar. Metanotum with two rows of setae (8, 6); main row very stout setae. Anterior scattered setae. Lateral margins of metanotum oblique from apex to lateral base; no apparent overlap with metepimeron. One pigmented marginal spinelet at dorsum. Lateral metanotal area with two setae. Metepisternum with one long seta; length of squamulum >2× width. Metasternum projecting ventrad between coxae. Pleural ridge stout; with hyaline ribbon-like sclerotization extended its length beneath. Metepimeron with 3 vertical rows of setae (5, 5, and 1)(anterior row



Figures 1-8. *Paractenopsyllus madagascarensis* sp. n. **1** Head and thorax, holotype ♂ (SMG-13919). **2** Head and thorax, allotype ♀ (SMG-13903). **3** Aedeagus, paratype ♂ (SMG-14002). **4** Apex of aedeagus, paratype ♂ (SMG-14002). **5** Basimere and telomere, mesal aspect, paratype ♂ (SMG-14002). **6** Eighth tergite, paratype ♂, (SMG-14002). **7** Eighth sternite, paratype ♂ (SMG-14002). **8** Ninth sternite, paratype ♂ (SMG-14002). Scale = 200µ

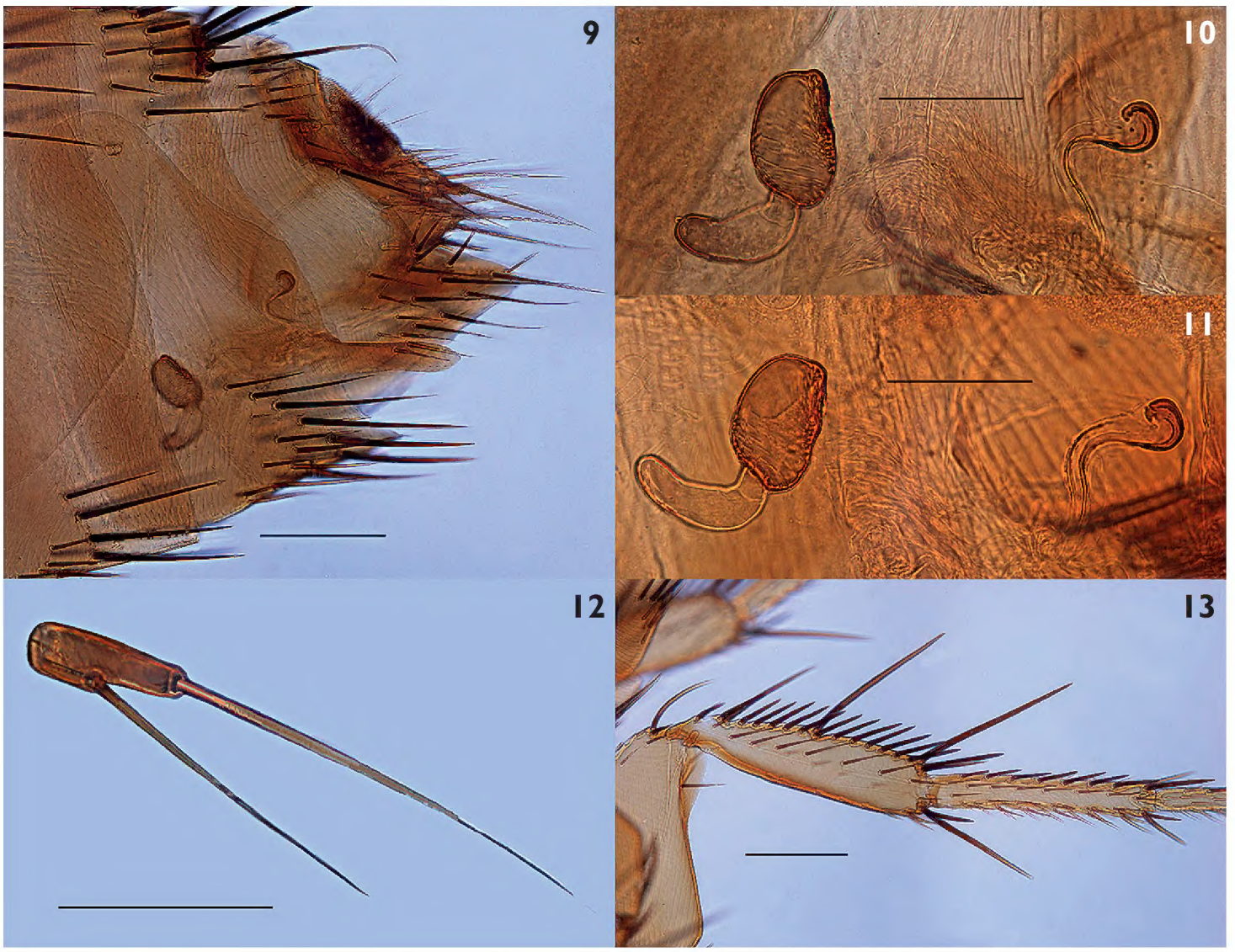


Figure 9-13. *Paractenopsyllus madagascarensis* sp. n. **9** Seventh sternite and terminalia, allotype ♀ (SMG-13903). **10** Spermatheca and bursa copulatrix, allotype ♀ (SMG-13903). **11** Spermatheca and bursa copulatrix, paratype ♀ (SMG-13935). **12** Anal stylet, paratype ♀ (SMG-13918). **13** Hind tibia, holotype ♂ (SMG-13919). Scale 9 and 13 = 200μ, 10-12 = 100μ

only 2 in female); spiracle longer than wide, rounded at apex. **Legs** (Fig. 13). Procoxa with more than 40 lateral setae; 2 long marginal setae along apical caudal margin. Lateral sulcus of mesocoxa more than 3/4 complete. Metacoxa with apical comb of 5 long setae extended over trochanter. Profemur with 5 small lateral setae; one small mesal seta. One femoral-tibial guard seta on profemur; two on other femora; lateral short and stout, mesal long and stout. Margin of fore, mid and hind tibiae with three dorsal notches each bearing a one long seta, interspersed with false combs of heavy dark bristles. Three lateral rows of setae on metatibiae (7, 10, and 8). Distotarsomeres each with five pairs lateral plantar bristles; first pair shifted onto plantar surface between second pair. Each distotarsomere with 2 spiniform preapical plantar bristles; row of 4 setae at apex extended over tarsal claw on dorsal side of segment in addition to usual preapical lateral hairs. Numerous fine setae on plantar surfaces of distotarsomeres. **Unmodified Abdominal Segments**. Terga I-VI have three rows of setae (anterior composed of only 1-2 minute setae). Tergum VII with two rows of setae; three antesensilial bristles (lateral and mesal less than half-length of middle bristle). One seta below level of each spiracle in main rows. Sternum II with one

stout seta; minute seta anterior to main seta. Sterna III-VII with main row of 3 stout setae, group of 6-8 smaller setae anterior to main rows. Sensilium with 18 sensilial pits. **Modified Abdominal Segments, Male** (Figs. 5-7). Tergum VIII extended onto basimere; with 3 long setae ventral to spiracle and group of 8-9 small setae dorsal to spiracle. Basimere of T-IX with few setae on lateral surface; mesal surface with oblique row of 8-9 minute setae from apex to middle of basimere. One long slender seta at caudal margin of basimere (may represent acetabular bristle). Telomere long, sides parallel with short marginal setae sparsely distributed along caudal and dorsal margins. Manubrium stout, long, and arched upward. Sternum VIII longer than wide with parallel sides; apex with sinus forming dorsal and ventral lobes. Lobes with 4-5 long setae; numerous shorter setae anterior to those on lobes. Distal arm of S-IX with sides of basal lobe somewhat parallel with fine long setae along caudal margin. Apical lobe of distal arm of S-IX tapering towards apex; fine setae on anterodorsal margin. **Aedeagus** (Figs. 3-4). Aedeagal apodeme long and narrow (length more than 5× maximum width). Proximal spur sclerotized extended to enveloping girdle of phallosome. Penis rods exceed apex of aedeagal apodeme. Median dorsal lobe bulged on dorsum; rounded at apex. Ventral margin of median dorsal lobe with rugulose area, subtended by lateral lobes. Crescent sclerite sclerotized, thick in outline. Sclerotized inner tube with ornate sclerotized structures at dorsal apex. Crochet leaf-like towards apex; pointed apex folded back onto itself. Base of crochet with dorsal triangular lobe bearing small paxillus. **Modified Abdominal Segments, Female** (Figs. 9-12). Three antesensilial bristles, middle only slightly longer than others. Tergum VIII with two large apical lobes; dorsal shorter than ventral lobe. Eleven to 12 short setae dorsal to spiracle VIII; 1 very long and 2 short setae just below spiracle. Dorsal lobe of T-VIII without setae; ventral lobe with 15-16 setae, apical setae longer. Mesal surface of T-VIII with four stout setae. Sternum VII with long parallel sided lobe (length 6-7× width). Oblique row of 6 stout long setae; 9-10 shorter setae anterior to main row. Hilla and bulga of spermatheca approximately equal in length; cribriform area flattened. Hilla slightly restricted at bulga. Bursa copulatrix reflected caudad as a smooth arch. Sclerotized portion of perula flattened on dorsum. Anal stylet expanded from base to one lateral seta; narrower from lateral seta to apex with one seta. Ventral anal lobe triangular; ventral margin with line of 3 very stout short setae and 3 stout long setae. Sternum VIII without setae

Length (slide mounted specimens): Holotype 3.2mm, male average: 3.1mm (n = 12; range: 2709-3247µ); allotype 3.3mm, female average: 3.4mm (n = 12; range: 3100-3844µ).

Etymology. The species bears the name of the country from which it was collected.

Remarks. The number of specimens of this new species is few and it appears to be limited to rodents of the murid subfamily Nesomyinae since six different species represented by three genera were infested. Its occurrence on *R. rattus* may be accidental, as this rodent is ubiquitous and plentiful but rarely infested by *P. madagascarensis*. Most of the species within the genus *Paractenopsyllus* infest either tenrecs, or murids, but not both (Table 1).

Table 1. Comprehensive listing of known hosts for the flea species in the genus *Paractenopsyllus* in Madagascar (**H** = Holotype, **L** = Lectotype, X = found on respective host species but not primary type).

Host Species	*albignaci*	*beaucournui*	*duplantieri*	*gemelli*	*goodmani*	*grandidieri*	*juliamarinus*	*kerguisteli*	*madagascarensis*	*oconnori*	*pauliani*	*petiti*	*randrianasolei*	*ratovonjatoi*	*raxworthyi*	*rouxi*	*vauceli*	*viettei*
Muridae, Murinae																		
Rattus rattus		**H**				X			X				**H**			X		**H**
Muridae, Nesomyinae																		
Eliurus grandidieri				X	X		X											
Eliurus majori									X							**H**		
Eliurus minor									X									
Eliurus myoxinus				**H**							**H**							
Eliurus taiva			**H**											**H**				
Eliurus tanala				X					**H**	**H**						X		
Eliurus webbi				X		**H**			X	X								
Gymnuromys roberti									X									
Nesomys rufus									X								X	
Tenrecidae, Oryzorictinae																		
Microgale brevicaudata															X			
Microgale cowani			X		X		**H**							X				
Microgale dobsoni			X			X					**H**		X				**H**	
Microgale droubardi			X															
Microgale fotsifotsy			X		X									X				
Microgale gracilis					X													
Microgale gymnorhyncha														X				
Microgale longicaudata			X		X		X											
Microgale soricoides			X		**H**													
Microgale sp.?		**H**																
Microgale talazaci														X				
Oryzorictes bova			X															
Oryzorictes tetradactylus								**L**										
Tenrecidae, Tenrecinae																		
Hemicenteles nigriceps																X		
Tenrec ecaudatus															**H**			

***Paractenopsyllus raxworthyi* Duchemin & Ratovonjato, 2004**
Figs 14-16

Material Examined. 1♂, (MR-265, DNA voucher F-290, BYU), Antsiranana Province, Andranomifototra (13°14.4'S, 49°35.2'E), 750-900 m elec., 5.4 km W Ankijabe, ex *Microgale drouhardi* G. Grandidier, 1934 (UADBA 46021), 11 IX 2002, M. Raheriarisena; 1♀, (MR-172), Antsiranana Province, Andohan Analamazava (13°14.8'S, 49°36.1'E), 3.8 km W Ankijabe, 600-900 m elev., ex *M. drouhardi* (UADBA 45933), 26 X 2002, M. Raheriarisena. Mammal specimens are deposited in the Université d'Antananarivo, Département de Biologie Animale (UADBA), Madagascar.

Diagnosis of female. Female sex (previously unknown) may be distinguished from all other species bearing two lobes on the caudal margin of S-VII and 28 or fewer ctenidia in the pronotal comb by the very broad and rounded lobes of the S-VII (Fig. 14). Most similar to *P. vauceli* Klein, 1965 in appearance of the spermatheca (distinctly longer that wide), but the two differ in the shape of the bursa copulatrix and perula. The caudal margin of the bursa copulatrix of *P. raxworthyi* is symmetrically curved from base to perula and the sclerotized dorsal portion of perula is elongated (Fig. 16).

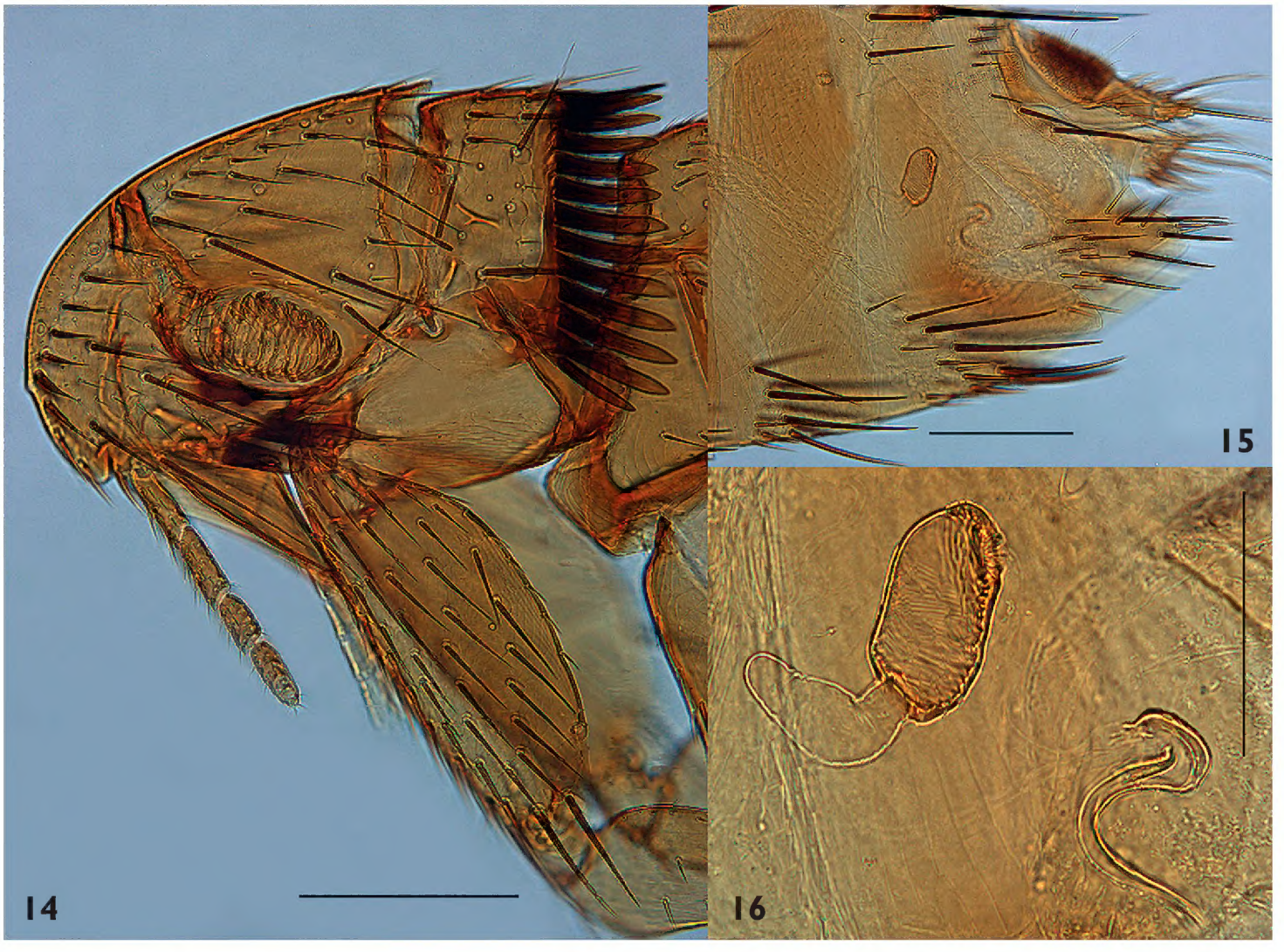


Figure 14-16. *Paractenopsyllus raxworthyi*, ♀ (MR-172). **14** Head and pronotum. **15** Seventh sternum and eighth tergum. **16** Spermatheca and bursa copulatrix. Scale 14-15 = 200µ, 16 = 100µ

Description of female. Unless otherwise stated, the female characters of *P. raxworthyi* do not differ from those of *P. madagascarensis* described above. **Head** (Fig. 14). Distance from frontal tubercle to oral angle less than from oral angle to base of first genal spine. **Thorax.** Pronotal ctenidia with 25 spines. Mesepisternum with only two small setae. Metepimeron with one seta in front anterior row. **Legs.** Same as *P. madagascarensis*. **Unmodified Abdominal Segments.** Sternites III-VI with 4 stout setae in main rows. **Modified Abdominal Segments** (Figs. 15-16). Antesensilial bristles 3; lateral and mesal bristles nearly as long as middle bristle. Only 3 setae on mesal surface of T-VIII. Caudal margin of S-VII with broad dorsal lobe subtended by sinus and much larger ventral lobe (length 2× maximum width).

Length (slide mounted specimens): Male: 2.0 mm (n = 1); Female: 2.7 mm (n = 1).

Remarks. *Paractenopsyllus raxworthyi* was known only from two males collected from *Tenrec ecaudatus* (Schreber, 1777) and *Microgale brevicaudata* G. Grandidier, 1899 from Antisiranana Province (Duchemin and Ratovonjato 2004). Our sole female specimen may prove to belong to another yet undescribed species, but we base our association of this female with that of the male sex of *P. raxworthyi* on the following criteria: 1, both specimens were collected in the same season (26 October, ♀, and 11 November, ♂), 2, both collected within the same narrow range of elevation (600-900 m), 3, both collected from the same host species (no other *Paractenopsyllus* species has ever been collected from this host species), and 4, the species is noticeably smaller than all other known species within the genus with the exception of *P. duplantieri* and *P. juliamarinus*. The length to width ratio of the bulga of the spermatheca of *P. raxworthyi* differs from the latter two species. Each of our specimens collected from a different specimen of *M. drouhardi* represent a new host record. DNA analysis was completed for the male for another study and is mentioned only for identification purposes. DNA analysis of both the male and female would have alleviated any doubt as to the identity of the female as *P. raxworthyi*. Unfortunately, the female was mounted on a glass slide before the authors realized its herein applied association with that of the *P. raxworthyi* male.

Acknowledgments

We thank Steven M. Goodman and colleagues for collecting fleas as part of their ongoing surveys of Malagasy mammal and ectoparasite biodiversity. The Direction Générale des Eaux et Forêts of Madagascar authorized permits to capture ectoparasites and their hosts. Collecting efforts received financial support from the Action Concertée des Instituts Pasteur, the World Wildlife Fund, and the Field Museum of Natural History. Ectoparasite specimens were processed and computerized under a grant by the National Science Foundation to Carl W. Dick, *et al.* (DBI-0545051).

References

Duchemin, JB (2003) Two new fleas (Siphonaptera: Ceratophyllidae: Leptopsyllinae) of Madagascar: *Tsaractenus rodhaini* sp. n. and *Paractenopsyllus* (*Consobrinopsyllus* n. subgen.) *goodmani* sp. n. Parasite 10: 351-358.

Duchemin, JB (2004) Leptopsyllines from Madagascar (Insecta: Siphonaptera: Ceratophyllidae): description of five new species of *Paractenopsyllus* Wagner, 1938. Parasite 11: 59-70.

Duchemin, JB, Ratovonjato, J (2004) Description de trois nouvelles espècies de *Paractenopsyllus* (Siphonaptera: Leptopsyllinae) de Madagascar. Parasite 11: 253-260.

Hastriter MW (2004) Revision of the flea genus *Jellisonia* Traub, 1944 (Siphonaptera: Ceratophyllidae). Annals of Carnegie Museum 73: 213-238.

Hastriter, MW (2009) A description of four new species of fleas (Insecta: Siphonaptera) from Angola, Ethiopia, Papua New Guinea, and Peru. Zookeys 8: 45-67.

Hastriter, MW, Eckerlin, RP (2003) *Jellisonia painteri* (Siphonaptera: Ceratophyllidae), a new species of flea from Guatemala. Annals of Carnegie Museum 72: 215-224.

Hastriter, MW, Whiting, MF (2003) Siphonaptera (Fleas), In: Resh VH, Cardé R (Eds), Encyclopedia of Insects, Academic Press, 1040-1044.

Klein, JM (1965a) Nouvelles espèces de *Paractenopsyllus* Wagner, 1938, puces de Madagascar: *P. grandidieri* sp. n., *P. petiti* sp. n. et *P. viettei* sp. n. (Siphonaptera). Bulletin de la Société Entomologique de France 70: 95-104.

Klein, JM (1965b) *Paractenopsyllus vauceli* sp. n., une nouvelle puce de la fôret orientale malgache (Siphonaptera). Bulletin de la Société Entomologique de France 70:157-160.

Klein, JM (1967) Nouvelles puces de Madagascar, *Paractenopsyllus randrianasoloi* sp. n., *P. albignaci* sp. n. et *Dinopsyllus tsaratananae* sp. n. (Siphonaptera). Bulletin de la Société Entomologique de France 72: 300-310.

Klein, JM, Grenier, P (1965) Redescription de *Paractenopsyllus kerguisteli* Wagner, 1938, et *P. pauliani* Lumaret, 1962. Bulletin de la Société Entomologique de France 70: 287-295.

Klein, JM, Grenier, P (1969) Puces de Madagascar. Description complémentaire de *Paractenopsyllus kerguisteli* Wagner, 1938 et clé illustrée de détermination des espècies du genre *Paractenopsyllus* Wagner (Siphonaptera). Cahiers de l' O.R.S.T.O.M., série Entomolgie Médicale Parasitologie 7(4): 329-339.

Lumaret, R (1962) Fauna of Madagascar. XV. Siphonapteran Insects. Publications of the Institute for Scientific Research, Tananarive-Tsimbazaza, 85-94.

Rothschild M, Traub R (1971) A revised glossary of terms used in the taxonomy and morphology of fleas [reprinted from G.H.E. Hopkins and M. Rothschild, An Illustrated Catalogue of the Rothschild Collection of Fleas (Siphonaptera) in the British Museum (Natural History)]. Vol. 5, 8-85.

Wilson DE, Reeder DM (2005) Mammal species of the world. A taxonomic and geographic reference. 3rd Ed., The Johns Hopkins University Press, Baltimore.